IN THE SPECIFICATION:

After the title please insert the following sub-title and paragraph:

CROSS REFERENCE TO RELATED APPLICATIONS

This application claims the benefit of PCT Application No. PCT/CH2004/000386, filed on June 24, 2004 and European Patent Application No. 03015094.0, filed July 3, 2003, the disclosures of which are herein incorporated by reference in their entirety.

Please insert the following heading prior to paragraph **[0001]**:

FIELD OF THE INVENTION

Please amend paragraph **[0001]** as follows:

[0001] The present invention relates to a magnetic resonance imaging method wherein undersampled magnetic resonance signals are acquired by a receiver antenna system having spatial sensitivity profiles ~~according to the preamble portion of claim 1~~. The invention is further directed to a magnetic resonance apparatus and a computer program product for executing the magnetic resonance method.

Please insert the following heading prior to paragraph **[0002]**:

BACKGROUND OF THE INVENTION

Please insert the following heading prior to paragraph **[0005]**:

SUMMARY OF THE INVENTION

Please amend paragraph **[0006]** as follows:

[0006] This object is solved by the method in which wherein spatially encoded undersampled magnetic resonance signals are acquired by one or more receiver antennae and one or more images are reconstructed from the spatially encoded undersampled magnetic resonance signals as a result of optimizing the spatial response function (SRF), which is defined by the spatial signal response from the object to be imaged, individually for each pixel of an image

~~as claimed in claim 1~~. The further objects are achieved by the magnetic resonance imaging system ~~according to claim 14~~ and the computer program product ~~according to claim 15~~. The system includes a static main magnet having a main magnetic field and the means for applying read gradient and other gradients. Means are provided for measuring MR signals along a predetermined trajectory containing a plurality of lines in k-space. A receiver antenna system acquires undersampled MR signals and includes a receiver antenna position with a spatial sensitivity profile. Means are provided for reconstructing the image from the undersampled magnetic resonance signals, and means for optimizing a cost function which determines the deviation of the spatial response function from a target spatial response function.

The computer program can be stored on a computer for forming an image by means of a magnetic resonance method when the computer readable program is executed. The program carries out the step of applying a read and other gradients, measuring MR signals along a predetermined trajectory containing a plurality of lines in k-space. Undersampled MR signals are acquired from a receiver antenna system in which each receiver antenna position has a spatial sensitivity profile. The image is reconstructed from the undersampled magnetic resonance signals. The program optimizes a cost function which determines the deviation of the spatial response function from a target spatial response function.

Please insert the following heading prior to paragraph **[0008]**:

BRIEF DESCRIPTION OF THE DRAWINGS

Please add the following paragraph and amend paragraphs **[0008]** – **[0014]** as follows:

The patent or application file contains at least one drawing executed in color. Copies of this patent or patent application publication with color drawing(s) will be provided by the Office upon request and payment of the necessary fee.

[0008] Further advantages of the invention are disclosed in the ~~dependent~~ claims and in the following description in which an exemplified embodiment of the invention is described with respect to the accompanying drawings. ~~It shows~~

[0009] Fig. 1 shows an aliased image and the spatial response function of the marked pixel in the image,

[0010] Fig. 2 shows a minimum-norm reconstruction at different iterations of the conjugate gradient algorithm,

[0011] Figs. 3a-3d show the panels of a zoomed portion of the reconstructions,

[0012] Fig. 4 shows the spatial response function (SRF) with minimum norm and conventional reconstruction,

[0013] Fig. 5 shows a phantom, conventional and minimum-norm reconstruction, and

[0014] Fig. 6 shows diagrammatically a magnetic resonance imaging system

Please insert the following heading prior to the title and paragraph **[0015]**:

DESCRIPTION OF PREFERRED EMBODIMENTS

Please amend paragraphs **[0061]** – **[0062]** as follows:

[0061] The magnetic resonance imaging system includes a set of main coils 10 whereby a steady, uniform magnetic field is generated. The main coils are constructed, for example in such a manner that they enclose a tunnel-shaped examination space. The patient 30 to be examined is slid on a table 14 into this tunnel-shaped examination space. The magnetic resonance imaging system also includes a number of gradient coils 11, 12 whereby magnetic fields exhibiting spatial variations, notably in the form of temporary gradients in individual directions, are generated so as to be superposed on the uniform magnetic field. The gradient coils 11, 12 are connected to a controllable power supply unit 20, 21. The gradient coils 11, 12 are energized by application of an electric current by means of the power supply unit 21. The strength, direction and duration of the gradients are controlled by control 20 of the power supply unit. The magnetic resonance imaging system also includes transmission and receiving coils 13, [[15]] 16 for generating RF excitation pulses and for picking up the magnetic resonance signals, respectively. The transmission coil 13 is preferably constructed as a body coil whereby (a part of) the object to be examined can be enclosed. The body coil is usually arranged in the

magnetic resonance imaging system in such a manner that the patient 30 to be examined, being arranged in the magnetic resonance imaging system, is enclosed by the body coil 13. The body coil 13 acts as a transmission aerial for the transmission of the RF excitation pulses and RF refocusing pulses. Preferably, the body coil 13 involves a spatially uniform intensity distribution of the transmitted RF pulses. The receiving coils [[15]] 16 are preferably surface coils [[15]] 16 which are arranged on or near the body of the patient 30 to be examined. Such surface coils [[15]] 16 have a high sensitivity for the reception of magnetic resonance signals which is also spatially inhomogeneous. This means that individual surface coils [[15]] 16 are mainly sensitive for magnetic resonance signals originating from separate directions, i.e. from separate parts in space of the body of the patient to be examined. The coil sensitivity profile represents the spatial sensitivity of the set of surface coils. The ~~transmission~~ receiving coils, notably surface coils, are connected to a demodulator 24 and the received magnetic resonance signals (MS) are demodulated by means of the demodulator 24. The demodulated magnetic resonance signals (DMS) are applied to a reconstruction unit 25. The reconstruction unit reconstructs the magnetic resonance image from the demodulated magnetic resonance signals (DMS) and on the basis of the coil sensitivity profile of the set of surface coils. The coil sensitivity profile has been measured in advance and is stored, for example electronically, in a memory unit which is included in the reconstruction unit. The reconstruction unit derives one or more image signals from the demodulated magnetic resonance signals (DMS), which image signals represent one or more, possibly successive magnetic resonance images. This means that the signal levels of the image signal of such a magnetic resonance image represent the brightness values of the relevant magnetic resonance image. The reconstruction unit 25 in practice is preferably constructed as a digital image processing unit 25 which is programmed so as to reconstruct the magnetic resonance image from the demodulated magnetic resonance signals and on the basis of the coil sensitivity profile. The digital image processing unit 25 is notably programmed so as to execute the reconstruction in conformity with the present invention. The image signal from the reconstruction unit is applied to a monitor 26 so that the monitor can display the image information of the magnetic resonance image (images). It is also possible to store the image signal in a buffer unit 27 while awaiting further processing, for example printing in the form of a hard copy.

[0062] In order to form a magnetic resonance image or a series of successive magnetic resonance images of the patient to be examined, the body of the patient is exposed to the magnetic field prevailing in the examination space. The steady, uniform magnetic field, i.e. the main field, orients a small excess number of the spins in the body of the patient to be examined in the direction of the main field. This generates a (small) net macroscopic magnetization in the body. These spins are, for example nuclear spins such as of the hydrogen nuclei (protons), but electron spins may also be concerned. The magnetization is locally influenced by application of the gradient fields. For example, the gradient coils 12 apply a selection gradient in order to select a more or less thin slice of the body. Subsequently, the transmission coils apply the RF excitation pulse to the examination space in which the part to be imaged of the patient to be examined is situated. The RF excitation pulse excites the spins in the selected slice, i.e. the net magnetization then performs a precessional motion about the direction of the main field. During this operation those spins are excited which have a Larmor frequency within the frequency band of the RF excitation pulse in the main field. However, it is also very well possible to excite the spins in a part of the body which is much larger ~~man~~ <u>than</u> such a thin slice; for example, the spins can be excited in a three-dimensional part which extends substantially in three directions in the body. After the RF excitation, the spins slowly return to their initial state and the macroscopic magnetization returns to its (thermal) state of equilibrium. The relaxing spins then emit magnetic resonance signals. Because of the application of a read-out gradient and a phase encoding gradient, the magnetic resonance signals have a plurality of frequency components which encode the spatial positions in, for example the selected slice. The *k*-space is scanned by the magnetic resonance signals by application of the read-out gradients and the phase encoding gradients. According to the invention, the application of notably the phase encoding gradients results in the sub-sampling of the *k*-space, relative to a predetermined spatial resolution of the magnetic resonance image. For example, a number of lines which is too small for the predetermined resolution of the magnetic resonance image, for example only half the number of lines, is scanned in the *k*-space.